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ABSTRACT

This paper attempts to provide a general equilibrium framework for comparing the merits of alternative methods of raising the income of the employable poor. The strategy is to specify a complete and interacting set of factor markets, parameterize alternative program types in a manner convenient to this specification, and then solve the system of equations that characterize this economy for the comparative static response to the initiation of a small version of each program type. Within the income maintenance category the rankings implicit in impact effect analysis recur when general equilibrium effects are considered. Wage subsidies are more transfer-efficient than the negative income tax, or earning supplements. The size of policy multipliers are, however, quite sensitive to elasticities of substitution in production. The general equilibrium impact of targeted employment and training programs is quite different from the impact effect. Expanding the employment of the skilled lowers the income of the less skilled, especially when elasticities of substitution and occupational choice are low. In general, equilibrium effects of transferring workers from the low to the high skilled work force imply that education and training are by far the most effective means of aiding the low skilled. (Author/AM)

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ABSTRACT

The comparative statics of a one-sector, three-factor competitive economy are analyzed by mathematically specifying the demand and supply functions for each factor and solving the resulting system of equations for the impacts of alternative antipoverty programs. Within the income maintenance category (NIT's, earnings supplements, and wage subsidies) the rankings implicit in impact effect analysis recur when general equilibrium effects are considered. Wage subsidies are more transfer efficient than the NIT or earnings supplement. The size of policy multipliers are, however, quite sensitive to elasticities of substitution in production. The general equilibrium impact of targeted employment and training programs is quite different from the impact effect. Expanding the employment of the skilled lowers the income of the less skilled, especially when elasticities of substitution and occupational choice are low. The general equilibrium effects of transferring workers from the low- to the high-skilled work force imply that education and training are by far the most cost-effective means of aiding the low skilled.

The General Equilibrium Impact of Alternative Antipoverty Strategies: Income Maintenance, Training and Job Creation

In recent years, a variety of strategies for reducing poverty have been suggested and tried. Since the defeat of the Family Assistance Plan, interest has tended to focus on programs that maintain stronger work incentives (i.e., those that condition payments on work effort). A small combination wage and earnings supplement plan was reported to the Senate by the Finance Committee in September 1972, and an earnings supplement for families with children is now law. Programs of direct employment in the public sector (CETA) and subsidized employment in the private sector (WIN, JOBS) are underway and growing.

Professional discussion of the comparative merits of wage supplements, earnings supplements, and NIT's is extensive (Barth, 1972; Garfinkel, 1973; Haveman, 1975; Kesselman, 1969; Zeckhauser, 1971). Much of the work, however, has implicitly assumed that rates of pay are unaffected by the choice and size of an income maintenance program. Evaluations of training programs have made the same assumption. It has frequently been pointed out that conclusions drawn from a partial equilibrium framework may not be valid when all market interactions are taken into account. Barth (1974) has shown in a one-sector partial equilibrium model that the parameters of the demand side of the low-skill labor market have substantial effects on the transfer efficiency (the increase in target group income per dollar of subsidy) of a wage supplement. Programs that increase the supply of low-skill labor (wage subsidies paid to employees) tend to lower their rates of pay. Miezkowski's (1974) examination of the impact of wage subsidies

and public employment programs in a general equilibrium model also showed that the assumed elasticities of substitution have important effects on the impact of the policy.

Antipoverty programs also have many important indirect effects on the economy. Programs that withdraw low-skill labor from the private sector--NIT's, employment programs, and training programs--tend to raise this wage. The market responses to antipoverty programs do not end there. Shifts in relative wages induce changes in training decisions which, over time, affect the skill composition of the work force. Changes in GNP due to labor-supply responses to income maintenance programs result in proportionate changes in saving and eventually in proportionate changes in the size of the capital stock. The rate of return on capital responds, and this in turn influences saving and hence the long run capital stock. When the distribution as well as the size of the pie is an issue of social concern, these general equilibrium adjustments become especially important.

This paper attempts to provide a general equilibrium framework for comparing the merits of alternative methods of raising the incomes of the employable poor. The strategy is to specify a complete and interacting set of factor markets, parameterize alternative program types in a manner convenient to this specification, and then solve the system of equations that characterize this economy for the comparative static response to the initiation of a small version of each program type. Solution of the system of equations produces policy multipliers for pre- and postsupplement wage rates, hours worked, target group income, the numbers of skilled and unskilled workers in the economy, and GNP. The program types considered

are wage supplements (WS), earnings supplements (ES), negative income tax (NIT), employment programs (EP), and education and training programs (E&T) and night school training programs (NST). The summary statistics upon which I focus are the change in GNP and the change in target group income (transfer efficiency) per dollar of program cost.[1]

The analysis confirms earlier findings that a wage supplement would promote work effort and increase GNP more than an earnings supplement or NIT. While the direction of program effects is not reversed by accounting for labor demand interactions, the magnitude of effects is changed, often substantially. A comparison of results for single labor market supply-demand models and full general equilibrium models suggests that analysis of a single labor market can be misleading. The most striking finding, however, is the powerful general equilibrium effect of education and training programs on GNP and on the income of the low skilled. Education and training programs (E&T) with impact benefit-cost ratios of one (and therefore no initial effects on GNP) have short-run transfer efficiencies as high as 13.7 and GNP multipliers as high as 2.5. High elasticities of substitution between high- and low-skill workers and/or high occupational choice elasticities lower these multipliers, but training programs (with impact B/C = 1) remain a considerably more efficient means of aiding the low skilled for all reasonable values of parameters.

In section 1 I mathematically characterize the simplified economy in which the effects of alternative antipoverty strategies will be simulated. The route by which each program influences this economy is also specified. In section 2 recent research on the values of the crucial parameters is

discussed. For some parameters--wage elasticities of labor supply and the impact effects of the NIT--a consensus has emerged. For others--elasticities of substitution, occupational choice elasticities, and saving elasticities with respect to the rate of return--controversy remains and so reasonable ranges are chosen for simulation. Section 3 presents the results and discusses their sensitivity to the choice of parameter values. Section 4 provides a summary of the paper, makes suggestions for future research, and draws a few tentative policy implications.

1. Specification of the Model

The simplest general equilibrium framework within which to analyze the effects of subsidies available to only part of the labor force is the three-factor, one-sector model of a competitive economy. Labor supply, occupational choice, choice of production technique, and savings are determined endogenously within the model. The specification of only one product market, however, precludes the analysis of product substitution and partial subsidies of a factor that are specific to a particular group of industries. The assumption of a closed economy means that immigration, international capital flows, and the quantities and prices of imports and exports are assumed to be exogenous to the model. The assumption that all markets are competitive implies that the demands for and supply of each factor of production are equilibrated by changes in real wages, and not by queuing or unemployment. While the use of a static equilibrium model greatly simplifies both the analysis and the presentation, it can not

give an exact characterization of the path of convergence to the final equilibrium. Extensions of the model which consider these phenomena would, of course, be useful but are beyond the scope of this paper.

Production Sector

The production sector of this economy is assumed to be characterized by a value-added production function that exhibits constant returns to scale (CRTS). All labor is aggregated into two skill groups: the low-skill group which receives the subsidy and the high-skill group which does not. The third factor is capital. All factors are paid their marginal products. All variables are written in their log form. The total derivative of the production function with respect to the inputs can be written as

$$dQ = \kappa_1 dX_1^s + \kappa_2 dX_2^s + \kappa_3 dX_3^s \tag{1}$$

where Q = the log of output

X_i^s = the log of the total supply of each factor

κ_i = the share of the "i"th factor in total compensation which sum to one $\sum_i \kappa_i = 1$.

Equation (1) implies that the elasticity of output with respect to the quantity of input i is equal to the "i"th input's share of total compensation. Equation (1) is an exact representation of a CRTS Cobb-Douglas production function whether factors are paid their marginal product or not. Cobb-Douglas technology is not needed, however, because as long as factors are paid their marginal product and inputs are defined in

efficiency units, equation (1) is a good local approximation of any constant returns to scale convex production frontier.

From the cost function that is dual to this production function, we derive factor demand functions. They may be locally approximated by

$$dX_i^s = dQ + \kappa_1\sigma_{i1}dP_1 + \kappa_2\sigma_{i2}dP_2 + \kappa_3\sigma_{i3}dP_3 \quad \text{for } i = 1, 2, 3 \qquad (2)$$

where symmetry makes $\sigma_{ij} = \sigma_{ji}$

$$\kappa_1\sigma_{i1} + \kappa_2\sigma_{i2} + \kappa_3\sigma_{i3} = 0$$

P_i = the log of the price paid by firms for the "i"th input

σ_{ij} = Allen partial elasticity of substitution between the "i"th and the "j"th inputs.

The assumption of constant returns to scale (CRTS) is responsible for the fact that the elasticity of demand for factor inputs with respect to output is unitary. Holding output fixed, the elasticity of demand for the "i"th input with respect to the price of the "j"th inputs is $\kappa_j\sigma_{ij}$ (Allen, 1968, p. 508). The sum over j is zero. Thus for given output, there is no change in factor demand if all inputs experience the same proportionate change in price. As a result of the constraints on the σ_{ij} and $\kappa_j\sigma_{ij}$, only two of the three factor demand functions are linearly independent.

The price of output is chosen as numeraire. It is convenient for the wage rates and incomes in the system to be denominated in real units so we constrain the change in the price of output to be zero:

$$\text{Change in the price of output} = dP = \kappa_1 dP_1 + \kappa_2 dP_2 + \kappa_3 dP_3 = 0. \qquad (3)$$

The production, factor demand, and price equations provide four linearly independent equations in seven unknowns--three-factor prices, three-factor quantities and the quantity of output. Factor supply is all that remains to be considered.

The Supply of Capital

In the short run (less than one year), the supply of capital is fixed. In the long run, the supply of capital is proportional to the level of total output ($\eta_{kQ} = 1$) and responds to the rate of return with an elasticity between 0 and +1. The positive response to the rate of return can be due to either a positive elasticity of savings with respect to the rate of return or to a higher savings rate on the part of capitalists (Branson, 1972, p. 398):

$$X_3^s = A_3' + \eta_{kQ}Q + \eta_{kr}W_3 + \eta_{kQ}\kappa_i R_{Ji} \quad (4)$$

where η_{kr} is the sum of the pure rate of return supply response and the "capitalists save more response;"

$\eta_{kQ}\kappa_i R_{Ji}$ reflects the fact that the money paid out to hire low-skill workers in an EP is saved just like other forms of labor income.

It is by no means clear that the sum of the pure rate of return elasticity of savings and the "capitalists are savers" effect is large or even positive. Two studies of the interest rate elasticity of personal saving (which is over half of net capital formation) have obtained opposite results (Weber, 1970; Wright, 1967). Corporations do save at a higher rate than individuals, but rational economic behavior on the part of individuals who own corporate stock would lead them to adjust their consumption behavior to changes in the value of their portfolios. Empirical work on the

consumption function supports this view (Ando and Modigliani, 1969; Rasche, 1972). The high-income individuals who receive a large share of asset income may have a higher savings rate, but unless their savings rate out of permanent income is drastically higher there is only a minor impact on the rate of return elasticity of savings.

The Supply of Labor

The supply of a specific type of labor has two distinct components: the occupational choice decision that determines the stock of people with a particular set of skills (N_i), and the hours of work decision by people with that skill. Since these two decisions operate multiplicatively, the total supply of labor is additive in the logs

$$X_i^s = N_i + X_i - R_J \quad \text{for } i = 1 \quad (5a)$$
$$\text{for } i = 2 \quad (5b)$$

where N_i = log of the number of people with the "i"th level of skill;

X_i = log of the average hours worked per year by people of this skill level;

R_J = impact of an employment program. The negative of the log of one minus the proportion of the skill group in the employment program.

The average hours worked by members of the "i"th skill group depends upon the wage level and the impact effect of the income maintenance program being simulated.

$$X_i = A_i + \phi_i P_i + h_i dX_i'/dR \quad \text{for } i = 1 \quad (6a)$$
$$\text{for } i = 2 \quad (6b)$$

where ϕ_i = wage elasticity of labor supply of the "i"th skill group;

h_i = proportion of the "i"th skill group eligible for subsidy. Eligibility is a function of demographic characteristics, not of industry of employment.

dX_1'/dR = impact effect of an income maintenance program on labor supply of the subsidized group as it is traditionally measured in simulations assuming fixed wage rates. It equals the elasticity of labor supply with respect to the proportionate increase in income that would occur if the income maintenance program did not change wage rates.

In a wage subsidy the worker receives a payment equal to (hours worked) (subsidy rate) (target wage - actual wage) if his wage is below the target wage but above a qualifying wage of somewhere between $1.00 and $1.75 per hour. Incentives to expand one's hours of work increase and incentives to quit one's current job in order to look for a higher wage job decrease. If the wage subsidy covers all members of the low-skill labor force, its effect on hours worked is given by the wage elasticity of low-skill labor supply (i.e., $\phi = dX_1'/dR$). Some proposed wage subsidies cover only household heads or only heads and wives in families with children. Eligibility criteria of this kind tend to increase the proportion of the funds that go to families below or near the poverty line. Since, however, the labor supply decisions of excluded groups--single teenagers and, under some proposals, wives--are highly responsive to higher wage rates, the impact on labor supply per dollar of program cost is lower. While the effect remains positive, a wage subsidy to household heads will have a smaller impact on labor supply than will a universal wage subsidy ($dX_1'/dR_{HHWS} = \gamma < \phi$).

Negative income taxes (NIT's) and earnings supplement programs (ES's) tend to reduce the labor supply of subsidized families. For the working poor and near-poor, the differences between an NIT and an ES are primarily symbolic. The formula for a family's NIT payment--guarantee

minus .5 times earnings--also applies to the recapture region of an earnings supplement. The bulk of the poor and near-poor families not already receiving categorical aid would fall in the recapture region of an earnings subsidy. Below the recapture range an earnings subsidy is a proportional wage subsidy. No payments are received if the individual completely withdraws from the labor market, so an ES increases the incentive for at least one member of a household to remain in the labor force. The difference between an ES and NIT lies primarily in the ES's incentive for household heads to remain in the labor force full time. The increased earnings from more than full-time work by the head or from labor force entry by other members of the family causes a reduction in the family's subsidy, just as in an NIT. Since it is these dimensions of labor supply that have the strongest income and substitution effects, the overall effects of an ES and an NIT on the labor supply of eligible families are quite similar.

The second source of wage rate responsiveness to the supply of labor is occupational choice. A worker can transfer from a low- to a high-skill job only by investing in human capital (schooling or on-the-job training). On-the-job training is assumed to be general training and to be offered by employers only in jobs that receive less than the going low-skill rate of pay. This rate of pay is $\overline{P}_0 = Z\overline{P}_1$, where $\overline{P}_1$ and $\overline{P}_0$ are the arithmetic values of the price of an hour of labor (i.e., $P_1 = \ln\overline{P}_1$) and Z is a constant between zero and one. From the point of view of the worker, the benefit-cost ratio for undertaking on-the-job training is a function of the ratio of the wage differentials for skill $(\overline{W}_2 - \overline{W}_1)$ to the wage sacrifice necessary to obtain an entry

level job that provides training ($\overline{W}_1 - \overline{W}_0$). The $\overline{W}$'s represent the arithmetic values of the postsubsidy average wage rate ($W_i = \ln\overline{W}_i$). Note that at or below the target wage the price of labor to the employer $\overline{P}_i$ is related to the average postsubsidy wage by $\overline{W}_i = (1-t)\overline{P}_i + (t)\overline{W}_t$ where t is the proportion of the difference between the producer-paid wage and the target wage ($\overline{W}_t$) that is paid as a wage subsidy. Thus the private benefit-cost ratio for training for jobs within the range of the subsidy is

$$\frac{B}{C} = D\frac{\overline{W}_2-\overline{W}_1}{\overline{W}_1-\overline{W}_0} = D\frac{(1-t)\overline{P}_2 + tW_t - ((1-t)\overline{P}_1 + tW_t)}{(1-t)\overline{P}_1 + tW_t - ((1-t)\overline{P}_0 + tW_t)} = D\frac{(\overline{P}_2-\overline{P}_1)}{\overline{P}_1-\overline{P}_0} \quad . \quad (7)$$

The parameter describing the wage subsidy (t) fails to appear in the benefit-cost ratio of training. Parameters describing an ES or NIT will also drop out of training's benefit-cost ratio if hours worked in the jobs yielding P_0, P_1, and P_2 are the same and the job trained for is in the range of subsidy.[2] Modeling the training decision in this way implies that the WS's, ES's and NIT's are neutral with respect to the incentive to engage in on-the-job training. This is only approximately correct since on-the-job training for jobs yielding substantially more than the breakeven wage is encouraged by WS's, ES's, and NIT's. Schooling (training that requires a reduction in labor force participation) is discouraged by WS's and encouraged by NIT's. I wish to compare programs that have equal initial effects on incentives to undertake education and training and, therefore, assume that students are not eligible for the NIT and ES modeled in this paper. Recognizing that certain kinds of training will be encouraged and others discouraged,

I assume that the overall effect is neutral. This then implies that the number of people in an occupation depends upon a benefit-cost ratio that is a function of the presubsidy wage rates only. The benefit-cost ratio originally defined in arithmetic metrics by (7) can be approximated in logarithmic metrics:

$$B/C = D\frac{(\bar{P}_2-\bar{P}_1)}{(\bar{P}_1-\bar{P}_0)} = D\left(\frac{\bar{P}_2}{\bar{P}_1} - 1\right) \div \left(1 - \frac{\bar{P}_0}{\bar{P}_1}\right) = \frac{D}{(1-\delta)}\left(\frac{\bar{P}_2}{\bar{P}_1} - 1\right) \approx \tag{8}$$

$$D'(\ln(\bar{P}_2/\bar{P}_1)) = D'(P_2 - P_1),$$

where D' = a constant that depends upon the discount rate, the payoff period, and δ.

Since the decision to undertake education or training is solely a function of this benefit-cost ratio, occupational stocks are a function of pay differentials only.

$$N_2 = A_2' + \theta(P_2 - P_1) \tag{9}$$

$$N_1 = A_1' - \frac{\kappa_2}{\kappa_1}\theta(P_2 - P_1) \tag{10}$$

where θ is the high skill group's elasticity of occupational supply.

$\frac{\kappa_2\theta}{\kappa_1}$ is the relative wage elasticity of supply of the low skill group on the assumption that a switch to the higher skill occupation requires education or training which causes a current sacrifice of output equal to the present discounted value of the increased productivity of the workers receiving training. κ_2/κ_1 translates a percentage change in one input into the corresponding percentage change in the other.

The labor-supply sector of the model consists of five behavioral equations--(6a), (6b), (4), (9), and (10)--and (5a) and (5b). The identities are now substituted into the first two of the input demand equations (2) and the production function (1):

$$dX_1 + dN_1 - dR_J = dQ + \kappa_1\sigma_{11}dP_1 + \kappa_2\sigma_{12}dP_2 + \kappa_3\sigma_{13}dP_3 \tag{11}$$

$$dX_2 + dN_2 - dR_J = dQ + \kappa_1\sigma_{12}dP_1 + \kappa_2\sigma_{22}dP_2 + \kappa_3\sigma_{23}dP_3 \tag{12}$$

$$dQ = \sum_{i=1}^{n} \kappa_i dX_i^s = \sum_{i=1}^{n} (\kappa_i dX_i + \kappa_i dN_i). \tag{13}$$

The system of equations describing our simple economy is completed by differentiating the remaining equations with respect to N_i, X_i, P_i and R. This nine-equation system is presented in matrix format in Table 1. The system to be solved has two of the three linearly dependent factor demand equations [(11) and (12)], a price of output constraint [(3)], a production function [(13)], three factor supply equations [(6a), (6b) and (4)], and two occupational choice equations [(9) and (10)].

From the policy multipliers that result from the solution of the above system of simultaneous linear equations one may calculate the per dollar of program cost impact of each strategy on target group income (SMTE) and on real GNP (ΔGNP/ΔS).

For employment programs I will assume the workers hired can produce real output exactly equal to their wages. Therefore:

$$\Delta GNP/\Delta S_i = 1 + (\frac{dQ}{dR_i} / \kappa_i).$$

For other programs:

$$\Delta GNP/\Delta S_i = \frac{dQ}{dR}/h_i\kappa_i.$$

Table 1

Matrix Representation of General Equilibrium Model

P_1	P_2	P_3	Q	X_1	X_2	X_3	N_1	N_2		WS	NIT	EP	IS	TR
$\kappa_1\sigma_{11}$	$\kappa_2\sigma_{12}$	$\kappa_3\sigma_{13}$	1	−1	0	0	−1	0	dP_1/dR	0	0	0	0	0
$\kappa_1\sigma_{12}$	$\kappa_2\sigma_{22}$	$\kappa_3\sigma_{23}$	1	0	−1	0	0	−1	dP_2/dR	0	0	0	0	0
.538	.294	.168	0	0	0	0	0	0	dP_3/dR	0	0	0	0	0
0	0	0	−1	.538	.294	.168	.538	.294	dQ/dR	0	0	0	0	0
.25	0	0	0	−1	0	0	0	0	dX_1/dR	−.25	.4	1	0	0
0	ϕ_2	0	0	0	−1	0	0	0	dX_2/dR	0	0	0	0	0
0	0	η_{kr}	η_{kQ}	0	0	−1	0	0	dX_3/dR	0	0	$-\kappa_1\eta_{kQ}$	$-\eta_{kr}$	0
$.55\theta$	$-.55\theta$	0	0	0	0	0	−1	0	dN_1/dR	0	0	0	0	1.3
$-\theta$	θ	0	0	0	0	0	0	−1	dN_2/dR	0	0	0	0	$-1.3\ k_1/k_2$

When the entire low-skill group is eligible for subsidy or employment:

$$\text{SMTE} = 1 + \frac{dX_1}{dR_1} + \frac{dP_1}{dR_1} .$$

For education and training programs:

$$\text{SMTE} = 1 + \left(\frac{dX_1}{dR_1} + \frac{dP_1}{dR_1}\right) / .3.$$

When the target group is only a proportion (h_1) of the skill group:

$$\text{SMTE} = 1 + \frac{dX_1^*}{dR_1} + \frac{dP_1}{dR_1}$$

where dX_1^*/dR_1 is the proportionate change in labor supply of the target group.

When subsidy programs are focused on other factor inputs:

$$\text{SMTE} = \left(\frac{dX_1}{dR_j} + \frac{dP_1}{dR_j}\right) \cdot \frac{\kappa_1}{\kappa_j} .$$

Note that induced changes in the number of low-skill workers are not included in the income multiplier for the low skilled. This is because the cost of successful training is assumed to be exactly equal to the rise in wages, thus the extra people being trained are no better off unless the training is subsidized. Including occupational choice effects would not, however, change the SMTE's by an appreciable amount,

2. Selection of Parameter Values for the General Equilibrium Model

There is as yet no consensus on the extent to which relative factor prices induce businessmen to change the proportions of each factor they

use. Complete sets of consistent factor demand equations for large sectors of the economy have been estimated in only a few studies. The fact that, using essentially the same data base (manufacturing), two of the best of these studies obtained widely contrasting estimates of elasticities of substitution should remind us of the limits of our current knowledge of elasticities of substitution between different skill classes of labor. The numerical evaluations of policy multipliers will be performed for the two greatly contrasting production environments presented in Table 2: one with very high elasticities of substitution (Berndt and Christensen, 1974) and the other with very low elasticities of substitution (Kesselman, Williamson, and Berndt, in press). Note that capital and high-skill labor are complementary ($\sigma_{32} < 0$) in both studies. Cross elasticities of demand for the "i"th factor are obtained by multiplying the σ_{ij} by the "j"th factor's share of compensation. Own elasticities of demand are derived by making use of the fact that $\Sigma\kappa_j\sigma_{ij} = 0$.

Labor supply parameters (γ_i, ϕ) are derived from work by Garfinkel and Masters (forthcoming, Table 11.2) that used data from the Michigan Panel Study of Income Dynamics. Their results are consistent with other nonexperimental studies of labor supply and with the results of the New Jersey Experiment (Watts, forthcoming). The low-skill workers

Table 2

Allen Partial Elasticities of Substitution

		Berndt and Christensen		
		Low Skill	High Skill	Capital
	Low Skill	--	5.51	2.92
Kesselman, Williamson, and Berndt	High Skill	.485	--	-1.94
	Capital	1.277	-.477	--

who would be eligible for a wage subsidy were assumed to have the demographic characteristics of people whose hourly wage rates in 1966 were less than $1.50. Teenagers and women--groups whose labor supply is quite sensitive to wage rates--form a large portion of this work force. As a result, low-skill labor's average wage elasticity (using hours worked at under $1.50 an hour by each demographic group as weights) was quite high: $\phi_1 = .25$. If only household heads in the low-skill work force are examined, the elasticity is .12. High-skill labor's wage elasticity of supply was calculated using hours worked at more than $2.50 by each demographic group as weights and -.08 as the wage elasticity for prime age married males. It was estimated to be zero.

Estimates of the impact effect of an NIT on labor supply of subsidized groups were also taken from Garfinkel and Masters' simulations (forthcoming, Table 11.3).[3] The median reduction in work effort by groups that would have been newly subsidized by an NIT was four-tenths of a percent for every 1 percent increase in income. Because an earnings supplement increases incentives for household heads to remain in the labor force, it should cause a smaller contraction of labor supply than would an NIT with the same tax rate and breakeven. We assume that the labor-supply reduction per dollar of subsidy paid to households with employable workers is 20 percent smaller for an ES than an NIT.[4] For an ES, therefore, $dX_1/dR = -.32$.

Estimates of the elasticity of occupational choice with respect to the relative wage of skilled work are not available. Studies of college attendance, however, do find a significant response to the college-high school wage differential. Using the starting wage of college graduates

as the college wage, Bishop (1977) obtained an attendance elasticity for the late 1970s that averages 1.014 for males and females 18 to 24. Freeman (1975) obtained an enrollment elasticity of .71 for 18 to 24 year old males using the log of the ratio of the starting college wage to average full-time earnings as the return variable and 3.15 using the log of the ratio of college and high school median incomes as the return variable. In the short and medium run, however, the stock of college graduates is necessarily less sensitive than these enrollment elasticities would indicate. Adjustment of the college labor supply to a new wage ratio requires forty years, a full working lifetime. Policy multipliers are presented for values of θ that should bound likely occupational supply responses: $\theta = .2$ and $\theta = 2.0$.

3. Results

The effects of alternative subsidy programs on GNP and on the income of low-skill workers have been calculated from the solution of the system of nine equations; they are presented in Tables 3 and 4. Table 3 presents results for an economy with high elasticities of substitution in production (those in the upper triangle of Table 2). Table 4 presents results for an economy with very low elasticities of substitution. The first line of each panel gives the change in GNP that occurs per dollar of program cost ($\Delta GNP/\Delta S$). The GNP effects are a consequence of changes in work effort by labor and changes in savings that result from changes in GNP or changes in the rate of return. Increases in GNP imply a welfare gain only if the presubsidy economy is suffering from dead weight burdens due

Table 3. Impacts on GNP and Income of the Low Skilled Per Dollar of Program Cost in an Economy with High Elasticities of Substitution

	Wage Subsidy	WS for Household Heads	Earning Subsidy	NIT	Employment Program Blue Collar	Employment Program White Collar	Investment Subsidy	Education and Training School or OJT	Education and Training Night School	Education and Training School B/C = .5
1. Impact Effect $\Delta GNP/\Delta S$	.25	.12	-.32	-.40	0	0	-	0	1.0	-.5
SMTE	1.25	1.12	.68	.60	0	0	-	1.0	1.0	.5
2. Single Labor Market	.24	.12	-.30	-.38	.05	0	0	.22	1.17	-.36
$\eta_{BP} = -4.569$	1.19	1.11	.76	.70	.26	0	0	2.12	1.87	1.19
LABOR DEMAND INTERDEPENDENT										
3. Short Run ($\theta = 0$)	.24	.12	-.31	-.39	.03	.00	-	.15	1.12	-.41
K fixed	1.21	1.12	.72	.66	.15	-.02	-	1.74	1.59	.94
LOW OCC. MOBILITY ($\theta = .2$)										
4. Short Run	.24	.12	-.31	-.39	.03	0	-	.14	1.11	-.42
K fixed	1.21	1.12	.73	.66	.14	-.01	-	1.68	1.53	.91
5. Medium Run ≈ 4 yrs.	.26	.12	-.33	-.41	.02	-.02	.22	.19	1.21	-.42
$\eta_{KQ} = .25$, $\eta_{Kr} = .05$	1.22	1.12	.72	.65	.14	-.02	.09	1.70	1.58	.91
6. Long Run	.30	.14	-.38	-.48	.04	0	0	.17	1.36	-.51
$\eta_{KQ} = 1$, $\eta_{Kr} = 0$	1.24	1.11	.70	.62	.15	-.01	0	1.69	1.63	.87
7. Long Run	.29	.14	-.37	-.46	.04	-.20	.64	.70	1.84	-.22
$\eta_{KQ} = 1$, $\eta_{Kr} = 1$	1.23	1.11	.70	.63	.12	-.09	.26	1.90	1.84	.99
HIGH OCC. MOBILITY ($\theta = 2$)										
8. Short Run	.24	.12	-.31	-.39	.03	.01	-	.08	1.06	-.45
K fixed	1.22	1.12	.72	.65	.13	.04	-	1.40	1.27	.77
9. Long Run	.30	.14	-.38	-.48	.03	.01	0	.10	1.30	-.55
$\eta_{KQ} = 1$, $\eta_{Kr} = 0$	1.24	1.11	.69	.61	.13	.04	0	1.41	1.37	.72
10. Long Run	.29	.14	-.37	-.47	-.05	-.15	.68	.43	1.60	-.37
$\eta_{KQ} = 1$, $\eta_{Kr} = 1$	1.24	1.11	.69	.62	.10	-.03	.30	1.55	1.51	.80
MEDIUM OCC. MOBILITY ($\theta = 1$)										
11. Medium Run ≈ 4 yrs.	.26	.12	-.33	-.41	.02	-.01	.22	.14	1.17	-.44
$\eta_{KQ} = .25$, $\eta_{Kr} = .05$	1.22	1.11	.72	.65	.13	.01	.09	1.53	1.42	.82
12. Medium Run ≈ 12 yrs.	.27	.13	-.35	-.44	.02	-.03	.22	.20	1.30	-.45
$\eta_{KQ} = .6$, $\eta_{Kr} = .12$	1.23	1.12	.71	.63	.13	0	.09	1.56	1.48	.12

Table 4. Impacts on GNP and Income of the Low Skilled Per Dollar of Program Cost in an Economy with Low Elasticities of Substitution

	Wage Subsidy	WS for Household Heads	Earnings Subsidy	NIT	Employment Program: Blue Collar	Employment Program: White Collar	Investment Subsidy	Education and Training: School or OJT	Education and Training: Night School	Education and Training: School B/C = .5
1. Impact Effect on $\Delta GNP/\Delta S$	.25	.12	-.32	-.40	0	0	-	0	1.0	-.5
SMTE	1.25	1.12	.68	.60	0	0	-	1.0	1.0	.5
2. Single Labor Market	.19	.11	-.24	-.30	.24	0	-	1.07	1.80	.16
$\eta_{BP} = -.763$	.94	1.05	1.07	1.09	1.22	0	-	6.34	5.07	3.79
LABOR DEMAND INTERDEPENDENT										
3. Short Run ($\theta = 0$)	.20	.10	-.26	-.33	.18	-.41	-	2.54	3.36	.86
K fixed	1.02	1.16	.97	.96	.91	-2.03	-	13.71	12.80	7.31
LOW OCC. MOBILITY ($\theta = .2$)										
4. Short Run	.22	.11	-.29	-.36	.11	-.18	-	1.23	2.13	.17
K fixed	1.11	1.14	.85	.82	.54	-.88	-	7.16	6.61	3.85
5. Medium Run = 4 yrs.	.23	.11	-.30	-.37	.11	-.23	.20	1.46	2.39	.26
$\eta_{KQ} = .25$, $\eta_{Kr} = .05$	1.12	1.14	.85	.81	.54	-.89	.04	7.20	6.66	3.87
6. Long Run	.27	.13	-.35	-.43	.13	-.21	0	1.49	2.58	.21
$\eta_{KQ} = 1$, $\eta_{Kr} = 0$	1.12	1.14	.84	.80	.55	-.89	0	7.20	6.70	3.85
7. Long Run	.24	.12	-.31	-.39	.10	-.55	.42	2.79	3.77	.91
$\eta_{KQ} = 1$, $\eta_{Kr} = 1$	1.12	1.14	.85	.81	.54	-.95	.08	7.45	6.92	3.99
HIGH OCC. MOBILITY ($\theta = 2$)										
8. Short Run	.24	.11	-.30	-.38	.05	0	-	.22	1.17	-.36
K fixed	1.19	1.12	.76	.70	.26	.01	-	2.09	1.83	1.18
9. Long Run	.29	.14	-.38	-.47	.06	0	0	.27	1.45	-.45
$\eta_{KQ} = 1$, $\eta_{Kr} = 0$	1.23	1.12	.71	.64	.27	.01	0	2.13	2.04	1.11
10. Long Run	.29	.14	-.37	-.46	-.06	-.20	.56	.59	1.75	-.28
$\eta_{KQ} = 1$, $\eta_{Kr} = 1$	1.22	1.12	.72	.64	.18	-.14	.40	2.36	2.25	1.23
MEDIUM OCC. MOBILITY ($\theta = 1$)										
11. Medium Run = 4 yrs.	.25	.12	-.32	-.40	.05	-.06	.22	.49	1.48	.25
$\eta_{KQ} = .25$, $\eta_{Kr} = .05$	1.18	1.13	.77	.71	.31	-.17	.14	3.06	2.79	1.67
12. Medium Run = 12 yrs.	.27	.13	-.34	-.43	.05	-.09	.22	.60	1.67	-.23
$\eta_{KQ} = .6$, $\eta_{Kr} = .12$	1.19	1.12	.75	.69	.30	-.19	.14	3.13	2.90	1.68

to an income tax or transfer program already in existence. The second line of each panel gives the change in the target group's income per dollar of program cost (SMTE).

The first two panels present the results obtained from partial equilibrium analysis. The impact effect (first panel) assumes that wage rates paid by employers are fixed. The second panel uses Barth's model of demand and supply in a single labor market to evaluate policy multipliers.[5]

The rest of the panels present full general equilibrium results for various assumptions about the elasticity of supply of capital and the responsiveness of occupational mobility to relative wages. The general equilibrium analysis produces smaller estimates of the transfer efficiency of programs that withdraw labor from the private sector (NIT, ES and EP) than single labor market analysis (compare panels 2 and 3). Programs which raise labor supply (such as the wage subsidy) have their transfer efficiency understated by a single-market analysis. We conclude, therefore, that analysis of market effects in only one market can be misleading.

Impacts that require adjustment of the capital stock and changes in occupational choice can take a long time to occur. Simulations of transitions of full-employment economies to new growth equilibria generally find it takes fifteen to forty years to eliminate 75 percent of the initial disequilibrium (K. Sato, 1966; R. Sato, 1963; Feldstein, 1974).[6] The formula given by K. Sato for the time it takes to cover 100ε percent of the displacement of the capital output ratio is

$$t(\varepsilon) = - \ln(1-\varepsilon)/(1-\kappa_k)\ (g^* + \delta + \mu) \qquad (14)$$

where g^* is the economy's growth rate, and δ and μ are, respectively, the rate of depreciation and obsolescence of capital stock. A capital share (κ_k) of .35 and a value of .09 for the sum $g^* + \delta + \mu$ imply that 25 percent of the displacement is covered in four years and 75 percent in nineteen years. Estimates of medium-run responses to subsidy programs are necessarily problematical. They are bounded, however, by the separate solutions obtained for the short and long runs. Furthermore, while the potential variability of the speed of adjustment is a source of uncertainty, the reasonable range of variation for a four-year $\eta_{\kappa r}$ or θ is considerably smaller than the variation of the corresponding long-run parameters. We present three sets of medium-run policy multipliers for an economy in which the long run $\eta_{\kappa r}$ = .2; the capital-stock takes four years to close 25 percent and twelve years to close 60 percent of the disequilibrium.[7]

Panel 5 assumes that the four-year θ is .2 and panel 11 assumes that it is 1.0. If the long-run θ were 2.0, panel 5 would be consistent with an economy in which training takes a year and only new labor force entrants undertake it. Panel 12 presents twelve-year multipliers for this same economy. Panel 11 presents four-year multipliers consistent with an economy with no training log and a four-year response on the part of older workers that is about 40 percent as large as the response of new labor force entrants.

<u>Wage Subsidies</u>

By the twin criteria of GNP effects and transfer efficiency, wage subsidies that focus on groups with a high labor-supply elasticity dominate most of the other strategies for aiding low-income workers.[8] Within the

income maintenance category (WS, ES and NIT), the ranking of programs produced by an "impact effect" criterion tends to recur when general equilibrium effects are used as the criterion. The increase in labor supply produced by the wage subsidy tends to drive down the presubsidy wage rate. The lower the elasticities of substitution, the larger this decline becomes. In the short run, when stocks of human and physical capital are fixed, substitution possibilities in production are especially important determinants of transfer efficiency. In the low-substitution economy, the universal WS's short-run transfer efficiency is 1.02--only marginally greater than the NIT's transfer efficiency of .96. In an economy with high elasticities of substitution, the WS's transfer efficiency is 1.21--almost double the NIT's .66. The GNP multiplier is also larger in the high-substitution economy (.24 rather than .20).

By adjusting the eligibility criteria for a wage subsidy it is possible to focus more of a wage subsidy's impact on families at or below the poverty line. One proposal of this type is to establish a wage subsidy limited to household heads (family heads and unrelated individuals). Because these groups have lower wage elasticities of labor supply than the excluded groups (wives and dependent children), the induced increase in labor supply would be smaller. This is the primary reason a wage subsidy for household heads (WSHH) has GNP multipliers in the .10 to .14 range, as compared to universal wage subsidy's GNP multipliers of .20 and .30. Only half of all low-skill workers would receive a WSHH. The uncovered workers would face slightly lower wages and would tend to reduce their work effort somewhat. Relative to a universal WS, the wage decline would be small,

however, so transfer efficiencies would consequently be higher when elasticities of substitution are less than one.

How does accounting for occupational mobility reactions affect policy multipliers? Allowing for a response of occupational choice to the changes in the relative wage induced by a WS causes a small increase in the GNP multiplier and a substantial increase in the transfer efficiency of the program (compare panel 3 to 4, and 8 or 6 to 9). The subsidy tends to lower employer-paid wages for the low skilled, which increases the incentive to undertake on-the-job training. Our GNP and transfer efficiency calculations do not include the higher wages earned by the workers who obtain training. Including these effects would raise a WS's transfer efficiency when $\theta = 2$ by only .015.

The assumption that the equilibrium capital stock is proportional to GNP ($N_{kQ} = 1$) but not responsive to rates of return ($n_{kr} = 0$) raises the estimated GNP impact (compare panel 4 to 6, or 8 to 9). The first-round effect of an expanded labor supply on outputs is reinforced by the tendency of savings and, therefore, the future capital stock to increase. If the supply of capital responds positively to the rate of return, the GNP impact of a WS for low-skill workers is slightly reduced (compare panel 6 to 7, or 9 to 10). Note that the effect is especially large when elasticities of substitution and occupational mobility are low. Under these circumstances a WS for low-skill workers tends to lower its own wage and raise the price of high-skill workers. Because high-skill labor and capital are complementary, this lowers the productivity and, therefore, the rate of return to capital. This then lowers savings,

which in turn lowers future capital stock and GNP. This process works in the opposite direction when low-skill workers are trained to fill skilled jobs. Workers are attracted to skilled occupations, lowering the wages that employers have to pay and raising the return on capital.

Earnings Supplements and NIT's

The general equilibrium analysis of the NIT and earnings supplement reinforces the conclusions derived from the partial analysis of impact effects. The reduction in labor supply produced by these programs does tend to raise low-skill wages, and this improves transfer efficiency. Savings adjustments to these programs, however, work in the opposite direction and produce further declines in GNP and transfer efficiency. Occupational mobility responses also tend to lower transfer efficiency and increase the GNP reduction. In the low substitution economy, the NIT's impact transfer efficiency of .6 rises to .96 when short-run labor demand and wage rate responses are accounted for. Low occupational mobility (θ=.2) lowers SMTE to .82, and high occupational mobility (θ=2) lowers it further to .70. GNP reductions per dollar of program cost first fall from a .4 impact effect to .33 with zero occupational mobility, then rise to a .38 reduction with high occupational mobility.

Employment Programs for Low-Skill Workers

In a competitive neoclassical economy, employment programs for low-skill workers have a positive effect on this group's income. The withdrawal of these workers from the private sector forces up the wage of

the low skilled and induces an increase in work effort. Both of these effects raise the income of the low-skill group. The transfer efficiency and GNP impact of targeted employment programs is greatest in an economy with low elasticities of substitution, when the induced wage rate changes can be quite large. The calculated changes in GNP assume that the employment program produces a service whose value is exactly equal to the program's cost. If the value of the output of a dollar spent in the public employment program is less than a dollar, GNP effects must be correspondingly reduced and may become negative.

Expanding Demand for High-Skill Workers

Since World War II government policies have tended to promote employment of the skilled. Industries that are intensive users of highly skilled workers--education, health, aircraft, ordnance, and state and local administration--have been growing very rapidly, primarily because of increased governmental purchases and subsidies. In the short run, the supply of skilled workers is fixed. The government (or the firms and nonprofit institutions that act as its agent) can hire more skilled workers only by bidding them away from other firms. The resulting rise in the skilled wage drives down the real wage of the low-skill worker. This has the additional effect of reducing the low-skill labor supply. When elasticities of substitution are high these effects are minor, when elasticities of substitution are low these effects are very large indeed. The immediate reduction in the income of low-skill workers is $2.03 for every extra dollar spent hiring skilled workers. GNP falls as well (by 41¢) because the lower low-skill wage

induces a reduction in labor supply. After a time, training decisions will respond to the rise in the skill premium, and the supply of skilled labor will increase and the low-skill wage will tend to rise again toward the previous level. The skilled worker employment program simulation illustrates an important lesson. When a government program requires highly specialized workers whose training takes considerable time, the government should expand the supply of high-skill workers (through training subsidies) before the program itself is allowed to expand. A "training-first" strategy will not only lower the ultimate budgetary cost of the program, it will also reduce, if it does not prevent, the rise in the skill premium and thus help achieve income distribution goals.

Investment Subsidies

In a full-employment economy an investment tax credit affects GNP and the income of other factors only to the extent that the supply of savings responds to the rate of return. This is not a new finding: Taubman and Wales (1969) demonstrated that in a neoclassical growth model a completely inelastic supply of savings ($\eta_{\kappa r} = 0$), implies that an investment subsidy will cause no change in capital stock or GNP. Even when the interest elasticity of savings is assumed to be unreasonably high ($\eta_{\kappa r} = 1$), an investment subsidy produces almost no benefits for the low skilled. Because high-skill workers are complementary in production with capital, they benefit to a much greater extent. When $\theta = .2$ and elasticities of substitution are low, a dollar of investment subsidy raises the income of the skilled by \$ .61 while raising the income of the low skilled by only \$ .08.

Education and Training Programs

The general equilibrium effects of education and training programs (E&T) seem to make them substantially more cost effective than is indicated by the standard evaluation methodology of comparing earnings of trainees and a matched control group. The training program simulated in this model is assumed to have a benefit-cost ratio of one, as conventionally calculated (impact B/C = 1), and to raise the low-skill workers' productivity by 30 percent. The present value of the increase in the trained individual's productivity is exactly equal to the cost of the training.[9]

The irregular time pattern of costs and benefits, however, makes it difficult for a static equilibrium model to characterize the outcome. This problem is finessed by defining costs in such a way that the timing of costs and benefits are identical. Costs are, therefore, the rent on the investment in human capital, rather than the value of the investment in human capital itself.[10] The tabulated multipliers assume that these costs are the classroom and study time spent by the student or trainee. This time comes at the expense of leisure (column 9 of Tables 3 and 4) and at the expense of work (column 8 of Tables 3 and 4). If training time comes at the expense of work, a B/C of one implies that there is no first-round impact on GNP.

In the second round, however, E&T operates like an employment program. At much lower cost it withdraws workers from the stock of low-skill labor, raising the wage of those who remain and inducing an increase in their supply of labor. These effects are especially large

if elasticities of substitution are low. There are no corresponding reductions in the labor supply of high-skill workers because the wage elasticity of average hours worked of people in these occupations is zero. In the short run, before occupational choice and the capital stock have had a chance to adjust to the new set of relative prices ($\theta = \eta_{\kappa Q} = \eta_{\kappa r} = 0$), the transfer efficiency (SMTE) of this strategy is very high (see panel 3 of Tables 3 and 4). When elasticities of substitution are high, every dollar spent raises the income of those trained and those who remain low skilled by $1.74. When elasticities are low, the short-run transfer efficfency is an astounding 13.7. This occurs because training 1 percent of the low-skill workers has a rental cost of only three-tenths of a percent of the low-skill wage bill but raises their wage rate by 3.35 percent and the hours worked of those who remain in the unskilled work force by three-fourths of a percent. Though transfer efficiency tends to diminish as time passes, it remains higher than the best alternative program, the WS. The GNP multiplier declines when passing time gives occupational choice decisions a chance to respond to the lowered wage premium for skill. The GNP multiplier may rise with time if the supply of capital is highly responsive to the rate of return. Since capital and high-skill labor are complementary, the reduced price of high-skill labor raises the productivity of capital and this induces an increase in savings.

Training programs have high transfer efficiencies and positive effects on GNP because they produce a net addition to the supply of high-skill labor available to the private sector by causing a subtraction from the

supply of low-skill labor. To the extent that there is in fact no such redistribution of the relative supplies of labor, these second-round effects on GNP and target group income would diminish to zero. In the program modeled in Tables 3 and 4, training costs are the foregone earnings of the student. No other costs are incurred. If some of the costs of a training program pay for the time of high-skill workers who supervise the student, SMTE's and GNP multipliers are reduced somewhat. If all training costs are time inputs of high-skill workers (i.e., learning time does not result in the student's producing less in his low-skill job), GNP multipliers will be 77 percent of those tabulated. The SMTE for such a high-skill intensive training program would be $SMTE^{H} = (SMTE - 1) .77 + 1$, or from 77 to 90 percent of those tabulated in column 8. The short-run SMTE's of 1.74 and 13.7 reported earlier become 1.57 and 10.8.

The ninth column of Tables 3 and 4 presents policy multipliers for a training program that does not withdraw the trainee from the low-skill labor force during the training period: all training costs are assumed to be foregone leisure time. Correspondence courses and night schools come close to fitting this characterization. Since the training activity reduces leisure rather than output, the impact GNP multiplier is one. Accounting for general equilibrium responses to the training program raises the GNP multiplier as it did the E&T multiplier. The night school GNP multiplier is roughly the E&T multiplier plus one. Transfer efficiency declines, however. The reduction in the low-skill labor supply is smaller because there is no subtraction during the training period, and this causes a smaller increase in the low-skill wage.

What happens to general equilibrium policy multipliers if training is organized inefficiently? As the impact B/C ratio falls below one, there tends to be a proportionate reduction in transfer efficiency. Large reductions in impact benefit-cost ratios will produce negative GNP multipliers for economies with high elasticities of substitution or high occupational choice response elasticities. Column 10 of Tables 3 and 4 presents policy multipliers for an E&T program that must train two workers to accomplish the transfer of one worker into the higher-skilled work force. The tabulated multipliers suggest that even highly inefficient E&T programs produce substantial income benefits for the low skilled. A training program with a B/C = .5 has a higher transfer efficiency than an NIT, an earning subsidy or public employment for all parameter combinations simulated. If elasticities of substitution are low, it has a higher transfer efficiency than a wage subsidy. The GNP multipliers tabulated in column 10 suggest, however, that if training programs are run at only half efficiency, the transfer of income to the low skilled comes at the long run expense of GNP. GNP multipliers are positive only in the low substitution economy and when the occupational choice elasticity is .2 or less. In the other simulations, the GNP reduction is generally smaller than that produced by an NIT but larger than that produced by a wage subsidy or employment program.

4. Summary and Suggestions for Further Research

The strategy of this paper has been to mathematically specify a complete set of interacting factor markets, parameterize alternative antipoverty program types in a convenient manner, and then solve the

system of equations that characterize this economy for comparative static responses to program parameters.

The first question to be examined was how the consideration of general equilibrium effects changes the ranking of programs relative to impact effect calculations in which wage rates are considered to be exogenous? Within the income maintenance category the rankings implicit in impact effect analysis recur in the general equilibrium. By the twin criteria of the GNP multipliers and transfer efficiency, wage subsidies are preferred to earnings subsidies or NIT's. Impact effects are often quite misleading for the other programs, however. In a full-employment economy with fixed wage rates but no unions or minimum wages (the assumptions implicit in an impact effect), an employment program for the low skilled does not benefit this group. When wages are allowed to respond, however, the GNP multiplier and transfer efficiency both become positive--especially when elasticities of substitution and occupational mobility are low. Employment programs for the high skilled (such as the space program) which have no first-round impact effect on the low skilled can have devastating effects on the low-skill wage rate if elasticities of substitution are low.

Another important finding is the powerful general equilibrium effects of education and training. Education or training programs with impact benefit cost ratios of one have short-run transfer efficiencies as high as 3.7 and GNP multipliers as high as 2.5 when elasticities of substitution are low. Time for occupational choice to respond or higher elasticities of substitution lower these multipliers. As long

as the impact benefit-cost ratios are greater than one, however, training programs remain considerably more efficient than alternative programs for aiding the working poor for all reasonable values of the parameters. The high benefit-cost ratios found for education and training programs when general equilibrium effects are included stands in stark contrast to the often stated view that "the evaluations and relevant research suggest that [the effect of education and training programs for the poor] on the reduction of poverty was minimal" (Levin, 1977, p. 179). The evaluations of antipoverty training programs which are the basis of such statements have only attempted to measure impact effects and are, therefore, an incomplete basis for evaluating success in achieving income distribution goals.

The second issue examined was how GNP multipliers and transfer efficiencies vary (a) as time passes and the economy approaches its long-run equilibrium values, or (b) in economies with substantially different values for crucial parameters. If training decisions are made before or at the time of entry into the labor market, the responsiveness of occupational supplies to a permanent shift in the wage premium for skill should increase with time. As time passes, the GNP multiplier and transfer efficiency of training and other programs that reduce the supply of low-skill workers will fall. The adjustment of the capital stock to the new equilibrium tends to reinforce initial impact effects. A high responsiveness of saving to the rate of return results in favorable GNP effects for programs (such as training) that lower the cost of a factor complementary with capital, high-skill labor.

The sizes of GNP and of low-skill income multipliers are quite sensitive to the elasticity of substitution between factors of production. Higher elasticities raise the multipliers for the wage subsidy and lower them for programs whose initial impact is to withdraw low-skill labor from the private sector--NIT's, earnings subsidys, employment programs and training.

What lessons for current policy does this analysis yield? Taking into account general equilibrium effects, the preferred set of policies for aiding low-wage workers and the employable poor seems to be training and wage subsidies. Subsidies of on-the-job training are, however, difficult to administer. OJT is an inseparable part of the production process. Thus, there is no way of knowing how much training is occurring and, therefore, no way of limiting the subsidy to training alone. Setting strict training standards may reduce somewhat the number of employers who get their labor costs subsidized without providing very much training. Close governmental surveillance has disadvantages, however. It inevitably increases the paper work and restricts the firm's flexibility. This discourages firms from participating in the program, thereby reducing the impact of the program for any given amount of subsidy per worker.

This problem can be avoided by integrating training and employment subsidies and not attempting to directly control the proportions of aid going to each. A variety of approaches are available and need to be studied. One alternative is to award vouchers of varying size and of limited duration to unemployed workers and new labor force entrants which can be taken to any eligible employer. This approach targets the subsidy at groups defined as needy by recent difficulties in getting a job. These

vouchers could result in the worker receiving an X-cent per hour premium over whatever the standard wage is for that job, where X would depend upon the wage rate, the amount of OJT, and/or the number of the worker's dependents. The minimum wage law would apply to the postsubsidy wage. Employees would receive the premium as part of their paycheck and employers would be reimbursed by the government. Alternatively the employer could be paid a Y-cent per hour premium where Y depends upon the amount of promised training and whether a worker is physically disabled, receiving unemployment compensation or AFDC payments, or is a new labor force entrant.

A second alternative is to offer subsidies to firms that expand their employment and training of low-skill workers. Job classifications eligible for subsidy would have to have some training component and a pay rate of less than $3.50 at the time the law is proposed. A firm would receive a subsidy only for eligible employment greater than 80 percent of a base period level.

The objective of these programs is to increase the employment and wages of the target population but not at the expense of the employment opportunities for other low-skill workers. Imposing upper limits on the number of subsidized employees a firm might employ would tend to defeat this objective: a firm will have an incentive to expand employment of low-skill workers, to offer higher wages to attract these workers, and to lower prices to find a market for the extra production only if it gets more subsidy in the process. If the firm is allotted only a fixed number of subsidized employees, the subsidy will be an outright gift to the firm and will only cause subsidized employees to replace unsubsidized low-skill workers.

The model presented in this paper is both too complex and too simple. While the complexity of the interactions in the model do not prevent the derivation of analytical results, they do make interpretation of the analytical solution overly burdensome. Therefore, a simulation approach to the presentation of our results has been necessary. On the other hand, the model neglects to treat a host of important labor market institutions and phenomena--tax systems already in place, minimum wages, unions, unemployment, immigration, and international trade, to name only a few. Extensions of the model to include these phenomena are highly desirable. The timing of program impacts also needs to be examined in an explicitly dynamic model.

However, as a model becomes more complex, the number of parameters for which consensus estimates are required rises. It is the availability of such consensus estimates that provides the fundamental constraint on the realism or complexity of a simulation model. Inclusion of unemployment and union wage behavior would require a large matrix of such consensus parameters.

This exercise in model-building has shown the sensitivity of general equilibrium outcomes to assumptions about the nature of substitution possibilities in our economy and the responsiveness of occupational choice to relative wages. Our ignorance of these fundamental behavioral relations is profound. It is hoped that empirical research on these two issues will be stimulated by the evident need for the answers.

FOOTNOTES

[1]Barth (1974) used transfer efficiency. It is not a measure of the welfare gain accruing to the unskilled group, nor a measure of incidence.

[2]It must also be assumed that the individual eligible for a wage subsidy of his on-the-job training costs is not a member of a family that is ineligible for an NIT or ES because of the high earnings of some other family member. Modeling the effects of subsidy programs on training decisions is a very complicated matter requiring a much more careful analysis than is possible here.

[3]The utility-function-based simulations of an NIT with a poverty line guarantee and a 50 percent tax rate imply that a program costing \$15.5 billion causes an earnings reduction of \$6.5 billion. Of this cost, 20.6 percent is due to the contraction of labor supply and so the impact $dX/dR = -6.5/15.5\ (1 - .206) = -.507$. Using the coefficient simulation from Garfinkel and Masters (forthcoming, Table 11.3), the estimate of the impact $dX/dR = -.357$. We choose $-.4$ as our estimate of impact dX/dR.

[4]According to Garfinkel and Masters, simulations find the per dollar disincentive of an ES is greater than that of an NIT. Persons with almost no earnings receive much larger awards in an NIT. Since their initial work effort is so small, there is a smaller reduction in earnings per dollar of subsidy than for people whose initial earnings are high enough to make them eligible for a large ES payment. Garfinkel and Masters do not, however, take account of the distinct effect of

an ES on the labor force participation of heads, so their results may be an overestimate.

[5]The elasticity of demand for low-skill labor with respect to its own price does not hold output fixed. It is obtained by assuming prices and quantities of other inputs to be fixed and substituting (1) into (2) and solving for dX_1/dP_1 yielding $\kappa_1\sigma_{11}/(1-\kappa_1)$. Holding output constant ($dx_1/dP_1 = \kappa_1\sigma_{11}$) causes the single market policy multipliers to deviate even more from the general equilibrium multipliers.

[6]Conlisk (1966) has shown that in a Keynesian economy (one in which there is unemployment and a savings rate that responds to the level of unemployment) the speed of adjustment is three times greater than the full employment models utilized by the Satos.

[7]These estimates of medium run policy multipliers are very rough approximations for they are based on static equilibrium model approximation to what is in reality a dynamic disequilibrium phenomenon.

[8]This is admittedly an incomplete basis for policymaking. Other considerations are (a) impacts on inflation and unemployment, (b) the reduction in voluntary leisure, (c) the reduction in wages for unsubsidized members of the skill class, and (d) administrative feasibility.

[9]General equilibrium policy multipliers for training are quite sensitive to the assumed cost of transforming a low-skill worker into a high-skill worker. Holding constant the B/C = 1, a 15 percent wage differential for skill implies that costs are lower by 50 percent and multipliers are almost twice as large.

10 A number of interesting issues are raised by the timing of the labor market impacts of training. A full discussion of them is, however, beyond the scope of this paper. They are discussed more fully in (Bishop, 1977). George Johnson is also working on this topic.

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